

REMARKS

Claims 1-23 are pending in this application. Claims 9-12 are withdrawn from consideration. Claims 21-23 are newly added. Support for the claim language may be found throughout the original disclosure. Reconsideration and allowance in view of the foregoing amendments and following remarks are respectfully requested.

Applicants note that the Examiner indicated that claims 13-20 are allowed in the Office Action Summary but has rejected claims 13-20 in the body of the Office Action.

Claim Objections

Claim 4 is objected to because of informalities. Accordingly, Applicants have amended claim 4 to recite the limitation "lattice-like shower head," which is recited in claim 1.

Claim Rejections – 35 U.S.C. § 112

Claims 5, 6, 17 and 18 have been rejected under 35 U.S.C. § 112, first paragraph.

The Examiner states that lines 2-5 of claim 5 recite the limitation "a distance between a surface of said dielectric material plate facing said slot antenna and a surface of said substrate is substantially equal to an odd multiple of a quarter of a wavelength of said microwave in a corresponding part," but there is no support for this limitation. The Examiner states that on page 14, lines 24-29 of the specification, the specification supports "distance between a surface of said dielectric material plate facing said slot antenna and a surface of the dielectric material shower plate facing the substrate is substantially equal to an odd multiple of quarter of a wavelength of said microwave in a corresponding part."

Applicants submit that the limitation "a surface of the dielectric material shower plate facing said substrate" was recited in the original claim 5 and was inadvertently removed in the amendment filed August 20, 2002. Therefore, Applicants have amended claim 5 and reincorporated the limitation "a surface of the dielectric material shower plate facing said substrate."

The Examiner states that lines 26-29 of claim 17 recite the limitation "a distance between a surface of said dielectric material plate facing said slot antenna and a surface of said substrate is substantially equal to an odd multiple of a quarter of a wavelength of said microwave in a corresponding part," but there is no support for this limitation. The Examiner

states that on page 14, lines 24-29 of the specification, the specification supports "distance between a surface of said dielectric material plate facing said slot antenna and a surface of the dielectric material shower plate facing the substrate is substantially equal to an odd multiple of quarter of a wavelength of said microwave in a corresponding part."

Accordingly, Applicants have amended claim 17 and incorporated the limitation "a surface of the dielectric material shower plate facing said substrate."

Therefore, Applicants respectfully submit that all pending claims are in full compliance with § 112 and respectfully request that the rejection of claims 5, 6, 17 and 18 under § 112, first paragraph, be withdrawn.

Claim Rejections – 35 U.S.C. § 103

Claim 1, 4, 6, 7, 8 and 13-20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Tetsuka *et al.* (Japanese Patent Publication 06-061153A) in view of Hama *et al.* (US Pat. No. 5,525,159) and Oyama (Japanese Patent Publication 02-237020).

Applicants respectfully traverse this rejection for at least the following reasons.

The Examiner contends that Tetsuka *et al.* discloses a plasma apparatus which has most of the elements recited in claim 1 but concedes that Tetsuka *et al.* fails to teach a lattice-like shower head formed of a metal pipe with holes oblique to the surface of the substrate. The Examiner contends, however, that Hama *et al.* teaches a plasma processing apparatus comprising two gas distribution inlets 86 and 66 which allow different gases to be supplied to the chamber. The Examiner contends that a gas distribution inlet 152 includes a lattice-like shower head (vertical pipe lattice 156) provided between the dielectric material shower inlet 82 and the substrate S to be processed so as to discharge a gas, which has a composition different from that the gas discharged from the dielectric material shower inlet, to a side of the substrate to be processed. Furthermore, the Examiner contends that the lattice-like shower head is formed of a pipe comprising a plurality of discharge holes 154 which allows gases to fully and uniformly cover the entire region of the substrate and thus it would have been obvious to one of ordinary skill in the art to provide the apparatus of Tetsuka *et al.* with the lattice-like shower head as taught by Hama *et al.* The Examiner also contends that Oyama teaches a metal shower head which has gas discharge holes 15 oblique to the surface of the substrate. The holes are inclined towards the center of wafer 13 to obtain a uniform film, thus it would have been obvious to one of ordinary skill in the art to provide a metal lattice-like

shower head of Tetsuka *et al.* in view of Hama *et al.* with the gas holes of Oyama. In response to the arguments filed March 5, 2003, the Examiner states that “the claimed invention only requires a plurality of gas discharge holes such that a normal to each of the holes is oblique to the surface of the substrate, therefore Tetsuka *et al.* in view of Hama *et al.* and Oyama satisfies this claimed configuration. Applicants respectfully disagree.

Applicants reiterate the previous arguments filed March 5, 2003. Specifically, in claim 1, the normal to each of the gas discharge holes is oblique to the surface of the substrate and each of the gas discharge holes is formed on a curved surface of the metal pipe allowing the process gas to be obliquely incident on the substrate so as to improve substrate in plane uniformity of a process. Indeed, when the process gas is incident obliquely the process gas is made to evenly spread over the entire surface of the substrate, thus the process uniformity is greatly improved.

In Hama *et al.*, the head 172 has pipe lattice 176 having supply holes 174 oriented downward as shown in Figures 12 and 14 of Hama *et al.* Therefore, in Hama *et al.* the gas exists through the holes vertically (i.e., normal) to substrate S.

In Oyama, a plurality of gas blowing holes 15 are formed on a shower plate 14 (see Figures 1-8 in Oyama). The holes 15 are formed in such a manner that the more they are located closer to the circumference, the more the holes are inclined towards a wafer 13. The gas which blows out from the holes 15 is thus concentrated on the wafer 13.

Moreover, as shown in Figures 1 and 3 in Oyama, all the vectors, representing the orientation of the gas jets when exiting the holes 15, converge towards the center of the wafer 13. Therefore, contrary to the invention recited in claim 1, Oyama’s shower plate 14 does not allow to evenly spread the gas over the entire surface of the substrate.

Consequently, Oyama does not provide a lattice-like shower head having an opening part wherein at least a part of the gas discharged from a dielectric material shower plate flows through to the side of the substrate. The holes in the shower plate in Oyama are simply provided on a shower plate which only corresponds to the dielectric material shower plate of the present invention. Therefore, if one were to combine the teachings of Oyama, i.e., providing holes to a shower plate, with the device of Tetsuka *et al.* in view of Hama *et al.*, the holes would be provided to the shower plate (dielectric gas plate 7 in Figure 1 of Tetsuka *et al.*) or (shower heads 62 or 82 in Figure 1 of Hama *et al.*, the shower heads 62 and 82 being

made of a dielectric material such as quartz, see col. 5, lines 4-7 of Hama *et al.*) and not to a metal pipe lattice-like shower head.

Moreover, the holes in the showerhead 14 of Oyama are arranged such that they are inclined at the periphery of the showerhead and as stated above the gas jets exiting all the holes converge towards the center of the wafer. Furthermore, the holes in Oyama are normal to the wafer at least at the center of Oyama's showerhead (see Figures 1 and 3 in Oyama). Consequently, at least at the center of Oyama's showerhead, the flux of process gas is vertically incident on the surface of the wafer to satisfy convergence of the gas jets toward the center of the wafer. Thus, Oyama teaches away from the invention recited in claim 1.

Therefore, Oyama does not disclose, teach or suggest "said lattice-like shower head is formed of a metal pipe comprising a plurality of gas discharge holes configured and arranged such that a normal to each of said holes is oblique to the surface of the substrate and each of said holes is formed on a curved surface of said metal pipe," (emphasis added).

According to MPEP 2141.02, ascertaining the differences between the prior art and the claims at issue requires interpreting the claim language, and considering both the invention and the prior art references as a whole. A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.* 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

With regard to claims 4-8 and 13-20, the Examiner concedes that Tetsuka *et al.* in view of Hama *et al.* and Oyama fails to disclose a distance between a dielectric material shower plate and a lattice-like shower plate, a distance between a dielectric material plate and a dielectric material shower plate, a distance between a slot antenna and a dielectric material plate, and a thickness of a dielectric material shower plate. However, the Examiner contends that a *prima facie* case of obviousness still exists because it would have been obvious to one of ordinary skill in the art to optimize the distance and thickness during routine experimentation in absence of showing criticality. Applicants respectfully disagree.

Applicants clearly stated in the specification, for example at page 9, lines 21-32, that according to the plasma processing apparatus of the present invention, an efficiency of excitation of the plasma is maximized by optimizing a thickness of the dielectric material part of the microwave introducing part (a thickness of the dielectric material separation wall plus a thickness of the dielectric material shower plate), and, at the same time, a microwave having

a large power can be supplied by optimizing a thickness of the dielectric material shower plate and a distance between the slot antenna and the dielectric material separation wall, and, thereby a more stable and high-density plasma can be efficiently produced. Moreover, as shown throughout the specification, for example in Figures 7-10 and related description, the various parameters, such as electron density and microwave power depend, for example, from various distances and thicknesses, such as for example the thicknesses of the dielectric material part, the thickness of dielectric material shower plate, the distance between the dielectric material shower plate and lattice-like shower plate or head, and the distance between the radial line slot antenna and dielectric material shower plate.

Therefore, Applicants submit that, contrary to Examiner's contention, the various features recited in claims 4-8 and 13-20 are non obvious over the relied upon prior art. Moreover, according to MPEP 2144.05, a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). In view of the above, Applicants submit that the Examiner failed to present a *prima facie* case of obviousness.

Consequently, neither of Tetsuka *et al.*, Hama *et al.*, or Oyama disclose, teach or suggest alone or in combination the subject matter recited in claims 1, 13, 16 and 17. Therefore Applicants respectfully submit that claims 1, 13, 16 and 17, and claims 4-8 and 14, 15, 18, 19 and 20 which depend from either claim 1, claim 13, claim 16 and claim 17, are patentable and respectfully request that the rejection of claims 1, 4-8 and 13-20 under § 103(a) be withdrawn.

Claim 2 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Tetsuka *et al.* (Japanese Patent Publication 06-061153A) in view of Hama *et al.* (US Pat. No. 5,525,159) and Oyama (Japanese Patent Publication 02-237020) as applied to claims 1, 4-8 and 13-20 above and further in view of Otani *et al.* (Japanese Patent Publication 06-260434). Applicants respectfully traverse this rejection for at least the following reasons.

Claim 2 is dependent from claim 1. Therefore, for at least the reasons provided above in claim 1, Applicants respectfully submit that claim 2 is patentable and respectfully request that the rejection of claim 2 under § 103(a) be withdrawn.

Claim 3 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Tetsuka *et al.* (Japanese Patent Publication 06-061153A) in view of Hama *et al.* (US Pat. No. 5,525,159), Oyama (Japanese Patent Publication 02-237020), and Otani *et al.* (Japanese Patent Publication 06-260434) as applied to claim 2, and further in view of Omi *et al.* (Japanese Patent Publication 11-302824). Applicants respectfully traverse this rejection for at least the following reasons.

Claim 3 is dependent from claim 1. Therefore, for at least the reasons provided above in claim 1, Applicants respectfully submit that claim 3 is patentable and respectfully request that the rejection of claim 3 under § 103(a) be withdrawn.

Claims 21-23 have been newly added. Claims 21-23 are dependent from claim 1. Therefore, for at least the reasons provided above in claim 1, Applicants respectfully submit that claims 21-23 are patentable. Moreover none of the relied upon reference, either alone or in combination, disclose, teach or suggest the subject matter recited in claims 21, 22 and 23.

CONCLUSION

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,
Pillsbury Winthrop LLP

By: 

Glenn J. Perry
Reg. No.: 28,458
Tel. No.: (703) 905-2161
Fax No.: (703) 905-2500

GJP/KXG
1600 Tysons Boulevard
McLean, VA 22102
(703) 905-2000